FAST WATERBORNE TRANSPORT IN THE EMISSIONS REDUCTION ERA: IN SEARCH OF WIN-WIN POLICIES[1]

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ABSTRACT

This paper discusses fast waterborne transport from the perspective of emissions reduction. The overall drive to reduce emissions naturally looks at speed reduction as one of the alternatives, both at the design and at the operational level. Since speed is the main attribute of fast ships, and since significant amounts of emissions can be reduced by going slower, perhaps an obligatory question is what does the future hold for fast ships. This talk attempts to look into this issue. Recent policy initiatives are also reviewed and an attempt to address the issue whether and to what extent win-win policies can be developed is made.

1. INTRODUCTION

The basic premise of fast waterborne transport is that there is value in speed. Indeed, for both passengers and cargo, reaching your destination sooner rather than later is considered to be the desirable alternative. The benefits mainly concern the economic added value of faster transit of people and delivery of goods, lower inventory costs and increased trade throughput per unit time. This choice has spurred, and to a large extend continues to do so, unprecedented technological advances in fast sea transportation, and in fact nothing epitomizes these advances better than the FAST series of conferences over the years. These advances concern topics such as hull design, hydrodynamic performance of vessels, engine and propulsion efficiency, and structural analysis, among others.

However, environmental issues as regards air pollution have brought a new dimension to fast waterborne transport. If this dimension has received little or no emphasis in the past, this is not so today, and it will receive even more attention in the future. Simply stated, a ship has to be environmentally friendly as regards air emissions. This general goal is true for all ships. But it is even more so for fast ships, simply because of the non-linear relationship between speed and fuel consumption. It is obvious that a ship that goes slower will emit much less than the same ship going faster. A simplistic argument can therefore be, “Do you really want to reduce emissions? Go slower”. In fact such an argument can make fast ships a prime target of any set of measures to be taken to reduce air pollution from ships.

This targetting may work in two alternate ways: (a) design new ships that are slower, and (b) operate existing ships at a reduced speed. Either way, this seems like a policy that is in the opposite direction of what designers of fast ships have traditionally followed, to ever increase the operational speeds that can be used. And if the argument to reduce speed is pushed too far, a provocative question might be, do fast ships have a future, given the drive to reduce emissions will be prevalent in the years ahead?

Figure 1, taken from Psaraftis and Kontovas (2009a), illustrates this point, by presenting an estimate of CO_2 emissions from the world commercial fleet by ship type-size combination. The data is from the Lloyds-Fairplay database and the base year is 2007. According to this

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analysis, containerships are the top CO_2 emissions producer in the world fleet, which is something to be expected. What is perhaps not so obvious to expect is that just the top tier category of container vessels (those of 4,400 TEU and above) are seen to produce CO_2 emissions comparable on an absolute scale to that produced by the entire crude oil tanker fleet (in fact, the emissions of that top tier alone are slightly higher than those of all crude oil tankers combined). The reason this is so is obviously speed. Which means that if speed is reduced, emissions will be reduced too, perhaps drastically.

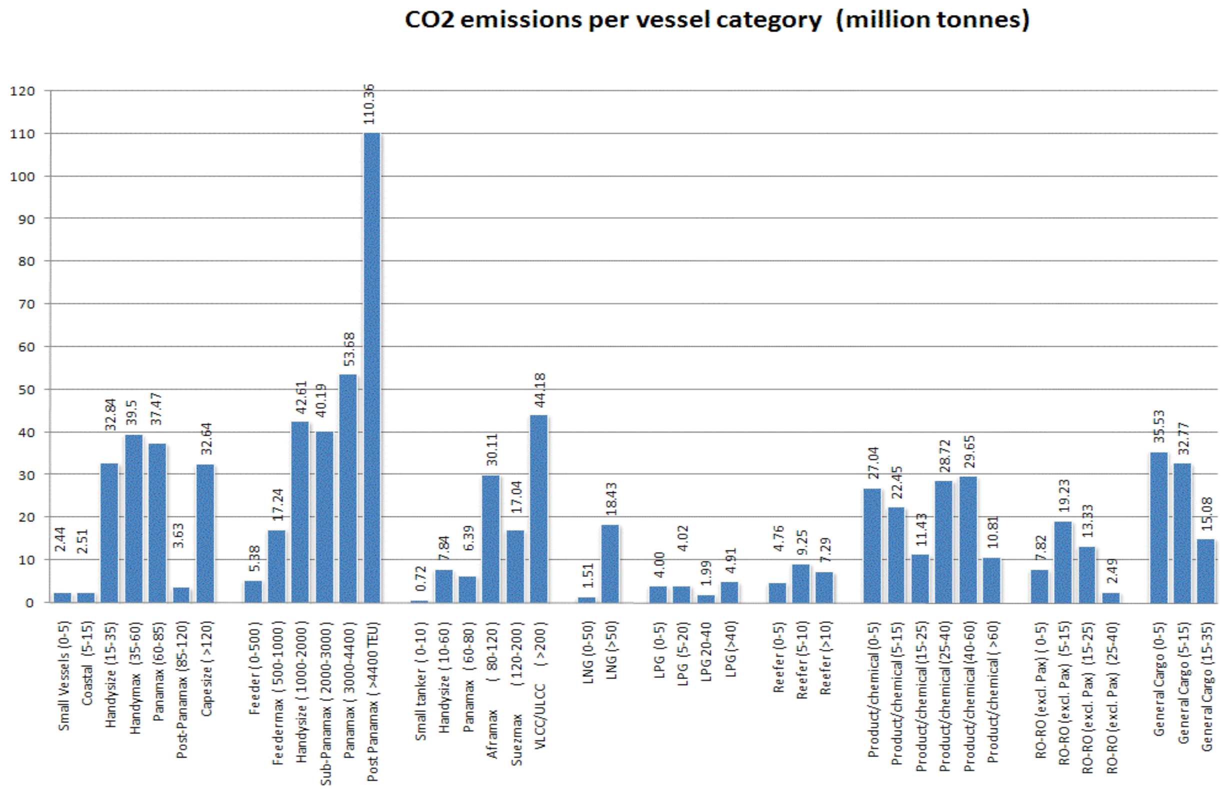

Fig. 1. CO_2 emissions, world fleet, 2007 (Psaraftis and Kontovas, 2009a).

Of course, the above figure refers to conventional cargo ships and does not include ships such as high-speed monohull, high-speed catamaran, hydrofoil, surface effect ships, or other. The overall contribution of these ships in terms of global emissions is speculated to be rather low, even though on a CO_2 per tonne-km basis their score should be significantly higher than that of conventional displacement ships. But one category of ships stands out vis-à-vis the others in the above figure in terms of speed: containerships.

Designing containerships of significantly lower operating speeds seems to be a projected trend that may be the norm for the future. Germanischer Lloyd (GL) first suggested slowing down some four years ago –and today, the idea has been accepted by most shipping lines in the container trade, said a GL spokesman. “A green ship is an efficient ship. We recommend that shipowners consider installing less powerful engines in their newbuildings and to operate those container vessels at slower speeds,” he said (Lloyds List, 2008a). By “slower speeds” it is understood that the current regime of 24-26 knots would be reduced to something like 21-22 knots, and some trades may even go as low as 15-18 knots, according to a 2006 study by Lloyds Register (Lloyds List, 2008b).

If going 26 knots is not considered “fast enough” in a technical sense, certainly going 15 knots is tantamount to a snail pace. There is no question that these reduced speeds would drastically reduce emissions. No question also that this would reduce bunker costs. The question is, is this really a win-win situation? We shall examine this question later.

2. RECENT DEVELOPMENTS

Before we consider fast ships, one natural question for someone to ask is, how much air pollution in total is produced by the world commercial fleet. This may seem like an easy question, but in fact it is quite the opposite, the main reason being the extreme difficulty in estimating bunker sales worldwide. There have been several estimates of the latter, by various methods, some of which are shown in Table 1 below.

Table 1: Comparison of Bunker Consumption Results of Various Studies.
Source: Psaraftis and Kontovas (2009a)

	Base year	Total (Mt)	Adjusted Total	2007 est. (Mt)
Eyring et al., 2005	2001	280	277	361
Corbett et al. 2003	2001	289	254	339
Endresen et al, 2007	2000	195	210	282
IMO Expert Group	2007	369	369	369
IEA total marine sales	2005	214	214	234
EIA bunker	2004	225	225	260
Buhaug et al., 2008	2007	333	333	333
Psaraftis and Kontovas, 2008	2007	298	283	283

One can multiply the results of this table by an appropriate "emissions coefficient" to estimate air emissions. For CO_2 the coefficient has been traditionally assumed equal to 3.17, even though the latest IMO Greenhouse Gas (GHG) study (Buhaug et al, 2008) has used slightly lower coefficients (from 3.021 to 3.082). For SO_x and NO_x which are not GHGs, the coefficients are much lower, and depend on the sulphur content of the fuel and on engine type (respectively)[2].

In spite of intense efforts by the international shipping community, regulating air emissions from ships has not been an easy proposition, and certainly progress on this front thus far has been mixed and very slow. On the positive side, one can note that last year the IMO has unanimously adopted amendments to the MARPOL Annex VI regulations. The main changes will see a progressive reduction in SO_x emissions from ships, with the global sulphur cap reduced initially to 3.50%, effective 1 January 2012; then progressively to 0.50%, effective 1 January 2020.

On the not so positive side, progress as regards regulating CO_2 and other GHGs continues to be very slow. In fact, the stated objective to finalize a mandatory Energy Efficiency Design Index (EEDI) of the environmental performance of new ships has not been reached yet. The same is true for the Energy Efficiency Operational Indicator (EEOI), which will be applicable to all ships. As a result, the IMO will not be in a position to have reached a clear position on these two indices in time for the United Nations Framework Conference for Climate Change

[2] An online free emissions calculator for CO_2 ,SO_2 and NO_x and various ship types and routes is at http://www.martrans.org/emis/

(UNFCCC) that will be held in Copenhagen in December of this year, when a new climate agreement is expected to be reached, after Kyoto in 1997.

At the latest meeting of IMO's Marine Environment Protection Committee in London last July (MEPC 59) there continued to be a clear split between industrialized member states, such as Japan, Denmark and other Northern European countries, and a group of developing countries including China, India and Brazil, on how to proceed. The latter countries spoke in favor of the principle of "Common but differentiated responsibility" (CBDR) under the UNFCCC. In their view, any mandatory regime aiming to reduce GHG emissions from ships engaged in international trade should be applicable exclusively to the countries listed in Annex I to the UNFCCC, therefore their strong wish is not to be included in any mandatory set of measures.

I don't want to go into technical details regarding these two indices, except to state that the first index (EEDI) concerns the design of new ships and the second (EEOI) concerns the operation of all ships, new and existing. Both indices are ratios, in which the numerator is a complex function of all energy consumed by the ship, and the denominator includes a product of the ship's deadweight (or payload) and the ship's operational speed. Even though speed is in the denominator, the fact that energy requirement includes a term that generally behaves like a cubic function of speed (fuel consumption at sea) means that fast ships are likely to score unfavorably as regards these indices vis-à-vis slower ships of the same DWT.

The implication of this is unknown, other than the fact than in any ranking based on these indices, fast ships will have an unfavorable environmental performance vis-à-vis slower ships of the same capacity. In spite of extensive discussions on this topic, it is still not clear exactly how these indices will be used in future IMO rulemaking. In fact, these indices still have not been finalized, as certain issues still demand discussion and agreement.

Progress as far as other measures to regulate GHG emissions, such as Market Based Instruments (MBIs) has been even slower. Reaction to this concept has been even more pronounced, and it is not clear which among two main schemes, the Emissions Trading Scheme (ETS) and the carbon levy, will be eventually adopted. Certainly no agreement will be reached before the Copenhagen UNFCCC conference, and the latest IMO timetable on this issue goes into 2012.

What does slow progress on GHGs mean? And what if no agreement is reached at the IMO any time soon? This will certainly increase the pressure for regional approaches. In fact the European Commission is following IMO developments very closely, and has stated very clearly its intention to act alone if IMO's procedures take longer than previously anticipated. As regards GHGs, the anticipated approach of the Commission is to formulate an ETS, similar to that used in other land-based industries. The Commission has started the procedure for including air transportation into its ETS scheme, and many think it will eventually do the same for shipping. Many ship owners circles (and most notably the Union of Greek Shipowners) have voiced strong concerns that such a scheme would be complicated and unworkable.

To coordinate policy in this area, the European Commission states in their Freight Logistics Action Plan launched in October 2007 that "*Logistics policy needs to be pursued at all levels of governance*", which is also the reason behind this action plan as one in a series of policy initiatives to improve the efficiency and sustainability of freight transport in Europe. In the Freight Logistics Action Plan a number of short – to medium-term actions is presented that will help Europe address its current and future challenges and ensure a competitive and sustainable freight transport system in Europe. Among the actions are the "*Green* transport corridors for freight". The Green Corridors are characterized by a concentration of freight traffic between major hubs and by relatively long distances of transport. Green Corridors should in all ways be environmentally friendly, safe and efficient. It is clear that fast ships will be involved in some of these Green Corridors, particularly those involving the Trans European Transport Networks (TEN-T's) and the Motorways of the Sea, and the question is, what ships, what types, what sizes, what speeds, and how will they be utilized.

3. IN SEARCH OF WIN-WIN POLICIES

"Win-win" is a nice set of words, the only problem being that finding win-win solutions may not always be easy. More often than not, the "push-down, pop-up" principle applies: if you push a certain button down, at least another one will pop up. Speed reduction is a prime example: if you make your container fleet go slower, you reduce emissions, you reduce fuel costs, and you also take care of vessel overcapacity, which is important when the market is depressed. That seems like killing three birds in one stone, so it looks pretty good, or a win-win proposition. But is that really the case?

It depends. Reducing speed may have other ramifications, which may not be beneficial. For instance, more ships will be needed to produce the same transport throughput. But this will entail some costs. Also, cargo in-transit inventory costs will generally increase. This is due to the delay in the arrival of the cargo. The inventory costs are proportional to the value of the cargo, so if you really have high-value goods, hauling them at a lower speed may entail significant costs.

As an example, if the average value of the cargo is $20,000/tonne, which is the case for certain classes of high-valued products, each day of delay in the delivery of one tonne of that cargo incurs a cost of $4.38 to the shipper, if the cost of capital is 8%. This may seem like an insignificant figure, but really it is not, and in fact increased in-transit inventory costs can be in the hundreds of millions of dollars and may make speed reduction a costly proposition to the owner of the cargo (see Psaraftis and Kontovas (2009b) for more details). So what may be good for the ship owner or whoever else pays the fuel bill may not be good for the owner of the cargo.

It is mainly the unwillingness of cargo owners to incur in-transit inventory costs that is the main factor behind fast ships and against speed reduction. For the transportation of high-valued products, fast ships will always have a place, and maybe with the focus on emissions reduction, these will be the kinds of cargo that these ships will mostly concentrate on, perhaps more than before.

Another push-down, pop-up effect is that in the short run, freight rates will go up once the overall transport supply is reduced because of slower speeds. At a minimum, the rates will not go down as much, and this may help the market, but shippers will foot the bill. This fact is seldom mentioned in any of the discussions on green maritime policies. The extent of the rate increase would depend on the particular scenario.

Yet another push-down, pop-up effect concerns effects that changes in fast ships may have on other modes of transport, to the extent these are alternatives to sea transport. This is the situation as regards many intra-European destinations. If ships are made to go slower, shippers may be induced to prefer land-based transport alternatives, mostly road, and that may increase overall GHG production. Road is certainly worse than maritime in terms of GHG emissions per tonne-km.

A similar "boomerang effect" may very well occur if another "green" policy initiative is followed. Already ECSA (the European Community Shipowners' Associations) has voiced concern that the use of fuel with lower sulphur within designated sulphur emissions control areas (SECAs) may have a reverse impact on the stated European Transport policy goal to shift cargo from land to sea, by making short-sea shipping less favourable to road transport, something that would ultimately lead to more CO_2 pollution. Currently in Europe the Baltic Sea, the North Sea and the English Channel are designated SECAs, and soon the entire North American coast will be similarly designated. Measures to reduce emissions in ports (such as cold ironing, and others) may, if not implemented properly, increase the cost of moving freight through ports and again discourage a shift from land to sea.

In the search for environmentally friendly policies, it is clear that a holistic approach is necessary, one that looks into and optimizes the overall supply chain instead of its individual components. Otherwise, the solutions are likely to be sub-optimal, both cost-wise and environment-wise. In that sense, fast ships should be viewed not in isolation, but as parts of the supply chain, and be treated as components of a larger system to be optimized. It would not make sense to reduce air pollution from fast ships only to see air pollution in the highways increase much more than its reduction at sea.

The example that comes to mind the most here concerns the role of ports. It clearly does not make sense to have a ship burn a lot of fuel to go fast, only to have the ship wait in line to be served by a congested port. All benefits of a reduced transit time would be eliminated if this is the case, not to mention that the increased air pollution would be in vain. Yet, in the discussions at IMO and elsewhere, this particular aspect has not received the attention it deserves. Ports are typically treated independently, and so do environmental matters regarding ports. Cold ironing, that is, the provision of electricity to the ship by plugging into the port's electricity supply system, is an idea that is likely to be the norm for many ports in the future.

A question that I have not seen addressed adequately is what air pollution will be produced by the generation of the extra shore electricity necessary for the cold ironing, and if that is less than the emissions saved by switching off the ship's auxiliary power at port. Also, if a port is congested due to heavy traffic, it may very well produce more air pollution than cold ironing may save. In my opinion, there should be a better connection between the sea leg and what happens in port, and this matters also to fast ships.

4. CONCLUSIONS

In the era of reduced emissions, fast ships will receive due scrutiny as regards their potential to reduce emissions. Other than technological advances (improved hull design, advanced propulsion systems, etc), which are of course necessary, operational measures and market based approaches to reduce emissions will be prevalent. It will not matter much to reduce the emissions of an individual ship, but those of the intermodal chain the ship is part of. And it would not make sense if measures to reduce emissions of that particular waterborne vehicle result in traffic being diverted to other modes that pollute more. The challenge will be to design such a system so that flows of goods are moved efficiently with the minimum overall amount of emissions. That challenge is easy to state but not so obvious to meet.

In closing, the fact that the FAST conference organizers have decided to put together a session on emissions is appreciated. This is an indication of the importance of this topic vis-à-vis fast waterborne transport. Together with all other papers, I am sure the papers presented there will provide interesting insights on this relatively new topic.

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